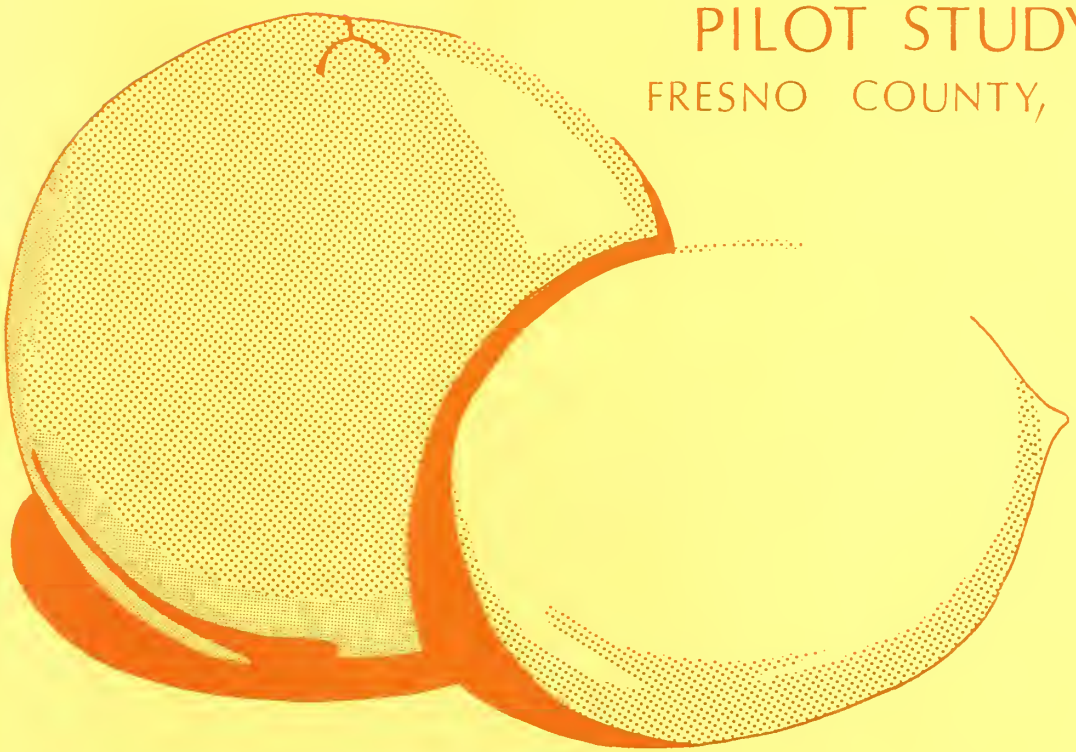
RESOURCE CAPABILITIES AFFECTING SEDIMENTATION
Mini – Report

CITRUS COVE PILOT STUDY AREA
FRESNO COUNTY, CALIFORNIA



Prepared By:

FRESNO FIELD OFFICE
AND
RIVER BASIN PLANNING STAFF
SOIL CONSERVATION SERVICE, USDA
DAVIS, CALIFORNIA

In Cooperation With:

NAVELENCIA RESOURCE
CONSERVATION DISTRICT
REEDLEY, CALIFORNIA

RESOURCE CAPABILITIES AFFECTING SEDIMENTATION MINI-REPORT

CITRUS COVE
PILOT STUDY AREA
FRESNO COUNTY, CALIFORNIA

JULY 1978

Prepared by the

FRESNO FIELD OFFICE
USDA, SOIL CONSERVATION SERVICE
Federal Building, Room 3302
1130 "O" Street
Fresno, CA 93721

and

U. S. DEPARTMENT OF AGRICULTURE
RIVER BASIN PLANNING STAFF
2828 Chiles Road
Davis, CA 95616

In Cooperation With

Navelencia Resource Conservation District
23168 East Jensen Avenue
Reedley, CA 93654

Technical studies and participation leading to this publication are as follows:

SOIL CONSERVATION SERVICE

Morris A. Martin, District Conservationist, Fresno Field Office
Michael Busch, Biologist, Fresno Field Office
James Chandler, Agricultural Engineer, Fresno Area Office
James Currie, Soil Conservationist, Fresno Field Office
River Basin Planning Staff, Davis, CA

RESOURCE CONSERVATION DISTRICT

Manual Silva
Charles Kridar
John Rose
Joe Ishii
Ray Bird

LOCAL MANAGEMENT TEAM

Frank Zabaldano, Executive Director, USDA, ASCS
Russ Bergford, California Department of Transportation
Don Ketscher, Director, Orange Cove Irrigation District
A. Lasotovich, Landowner
Helen McIver, Landowner
Jeff Taylor, Manager, Kings River Conservation District
Robert Kutz, California Department of Forestry
Ed Corn, Fresno County Agricultural Commissioner
Ed Armstrong, California Department of Fish and Game
Elizabeth J. Glenn, Secretary to the Navelencia Resource Cons. District
Harry I. Nightingale, Ph. D., USDA, Science and Education Administration
Manual Silva, Navelencia Resource Conservation District
Charles Kridar, Navelencia Resource Conservation District
John Rose, Navelencia Resource Conservation District
Joe Ishii, Navelencia Resource Conservation District
Ray Bird, Navelencia Resource Conservation District

TABLE OF CONTENTS

LIST OF TABLES

LIST OF MAPS

RESOURCE CAPABILITIES AFFECTING SEDIMENTATION

CITRUS COVE PILOT STUDY AREA

CHAPTER I - SUMMARY

The predominant land use in the Citrus Cove 208 Pilot Study Area is non-irrigated grazing and rangeland, which comprises approximately 52 percent of the study area. There are 5,170 acres in the study area. Of major importance for this study are the citrus and avocado groves which comprise roughly 30 percent of the study area. The other 18 percent of land use is comprised of small acreages of irrigated grazing, non-irrigated grazing, non-irrigated wheat, irrigated deciduous fruits and nuts, and transportation.

Soils of the area are placed in seven erodibility classes with factors (K) ranging from 0.15 to 0.37. Importantly, 25 percent of the land has a K value of 0.24, and 24 percent has a K value of 0.28. None of the other classes exceed 17 percent of the land area. Seventy percent of the land has an allowable soil loss of 2 tons/acre/year, 25 percent has a figure of five tons/acre/year and the rest, 1 ton/acre/year. Rainfall (Rt) factors range from 10 to 40 over the area with roughly 82 percent being associated with Rt values from 15 to 25.

Much of the land in Citrus Cove is flat or gently sloping, with approximately 50 percent of the land having slopes of 9 percent or less. Most of the crops are grown on this land. All of the streams in the flatter sections of the area have been filled in, reduced to small ditches and planted with various crops. The streams do, however, still exist in the upland portion of the watershed. There are approximately 14 miles of roadway present, with most of it occurring in the lower section of the study area.

CHAPTER II - INTRODUCTION

The restoration and protection of water quality in the nation's streams represents the goal outlined in the Federal Water Pollution Control Act (Amendments of 1972). This Act requires the control of both municipal and industrial wastes (point sources) and diffuse sources of materials (non-point sources) which degrade water quality. The individual states have been charged with the task of preparing water quality management plans for those sources which discharge into streams and coastal waters under their jurisdiction.

In California, the task of preparing water quality management plans for non-point sources was assigned to the State Water Resources Control Board and the several Regional Water Quality Control Boards under Section 208 of PL 92-500. The approach of these water quality control boards is to identify problem areas which contribute pollutants to water.

Of the possible sources of water pollution cited by the California Regional Water Quality Control Board Central Valley Region (Regional Board), soil erosion was one. To study this problem in depth, the Soil Conservation Service (SCS) was selected to conduct studies which would determine local sources of erosion problems and recommend solutions to the Regional Board. Studies in eight pilot study areas are now being conducted to determine the magnitude of the soil erosion problems in each area and to select the combination of practices which could best resolve them.

In order that the scheduled recommendations will be acceptable to local landowners, Local Management Teams have been organized for each of the pilot study areas by their affected Resource Conservation Districts. Concerns such as economics, impact on soil, crop and water management, and local institutional arrangements are all areas in which input from the Local Management Teams will be encouraged.

Each pilot study area was selected to represent a particular condition and its associated problems. These studies will be published in a series of mini-reports, of which this is the first.

One of the conditions implicated for degradation of water quality by the SCS are the citrus and avocado orchards, which are planted on foothill land. These frost sensitive crops are widely grown in the "thermal belt," an area of the lower foothills in which cold air "drains" away from the slopes, minimizing frost control expense. To aid this drainage and the radiation of heat from the soil to the crop, the soil cover must be managed. A commonly used management practice has been to keep the surface totally bare by use of herbicides. The combination of sloping and totally bare land between the tree rows has led to soil erosion from rainfall and irrigation tailwater runoff. The Citrus Cove Pilot Study Area was selected as representative of this situation.

The land in this study has historically been used for dryland and irrigated pasture, range, hay, grain and other field crops. The trend over the last 20 years has been to plant orchards. Olives and deciduous fruit were replaced by citrus and avocado, and the latest development was a return to deciduous stone fruit. Of interest, during the citrus development period, were very large sub-soiling machines that were especially developed for this area and ripped the hardpan soils of the thermal belt. The rolling area of residual soils was also extensively modified by leveling. Many rock outcrops were destroyed and buried, which somewhat changed the character of the landscape.

This study area is a watershed drained by a network of unnamed intermittent channels discharging into Buttonwillow Creek. Buttonwillow Creek is a remnant of an intermittent natural drainage arising in Citrus Cove and making its way to the Kings River south of Reedley. This creek has been channelized, relocated and integrated into the Alta Irrigation District distribution system, losing its identity below Reedley. Depending on several potential delivery routes, runoff from the original drainage area of Buttonwillow Creek will reach the Kings River at points from Reedley to below Kingsburg.

In order to better understand the nature and characteristics of the land being studied, seven general factors are considered. They are: soils, topography, land use, farming methods and practices, and major roads and streams in the area. In the Water Quality Planning Study, these factors were used to help designate eight different pilot study areas which would be representative of the overall Valley Region.

Four major soil associations are found in the study area. The upper watershed, surrounding the drainage in an arc from north to east, has rolling to very steep residual soils formed on granite. These are coarse sandy loams of the Vista and Fallbrook series. Closely associated with them are deep alluvial sandy loams of the Visalia, Hanford, Greenfield and Chino series--all recently formed on outwash from the granitic foothills.

Fine sandy loams and loams predominate in the surface with clay loams and clays in the subsoil overlaying old compact granitic alluvium. The predominant soil series present here are the Ramona, San Joaquin and Cometa. Low swales hold bodies of Alamo and Hildreth clays with slow permeability rates. The San Joaquin soils have hardpans, most of which have been ripped to three or four foot depth in preparation for planting of trees. This group of soils about equals the residual granitics described above. The two comprise more than 95 percent of the total area.

The remaining soils are formed from basic rocks of the old range, which preceded the granites of the Sierra uplift. A small body of Cibo and Porterville clays are found on the flank of Granite Ridge, which rims the watershed on the south.

Over half of the watershed occupies a relatively flat valley floor. Much of the naturally occurring micro-relief has been removed by leveling for irrigation. At the base of the rocky hillsides is a foot slope of 5 to 30 percent; this is the "thermal belt," prized for the production of frost sensitive citrus and avocados. There is a sharp break in slope where the rocky slopes, generally greater than 45 percent, mark the annual range grazing lands.

Elevations of the rim on the north and east range from 750 to 1,700 feet MSL (mean sea level) averaging 1,300 feet MSL. A transect of the floor of the watershed from east to west shows a drop of 200 feet (from 700 to 500 feet MSL) in one mile. In the next mile and three-quarters to the outlet, the drop is only 60 feet. On the south, Granite Hill rises steeply to 717 feet MSL.

The study area is slowly changing to permanent tree crops on the arable acreage. An initial rapid growth in citrus acreage in the sixties has more recently been followed by a slow trend toward deciduous orchards. Citrus and avocados have nearly filled all the upper slopes of the valley floor, while deciduous fruit is displacing the few areas of grass and field crops left on the more level portions.

The farming activity in this study area is comprised of grazing, fruit crops, dryland grain and irrigated field crops. Grazing land occupies about 54 percent of the total watershed. It is composed of the steep rocky range of the rim and a few fields of irrigated and dryland grazing of the floor. Of the cropped land, citrus and avocados comprise 78 percent, deciduous fruit, 9 percent and olives, 3 percent. The remaining percent is dryland grain and irrigated field crops.

Several different farming methods are used to maximize crop productivity in this area. The citrus and avocados have been grown under "weed free-non-tillage" in which herbicides keep the land totally bare. On some slopes, severe erosion has been induced by this method. To relieve this condition, a winter annual cover crop, which is periodically mowed to keep the cover low, has been tried with varying success and cost effectiveness. This cover has included surface mulches of wood chips, decomposed granite or straw.

The deciduous fruit usually have a winter crop of volunteer annuals. Many include summer cover to control sizing and ripening, tilling the soil only for convenience in irrigation. Field crops are grown using common tillage methods for seed bed preparation, irrigation and weed control.

Much of the irrigation water is provided by wells, with occasional "wagon wheel" types, tapping the water trapped in fractures of the base rock. This source is limited in the rate of recharge, so new plantings are restricted to "new" sources of water. Improvement in irrigation efficiency is progressing as surface furrows are replaced by sprinklers and drip systems. This has permitted some increase in acreage; but, at the same time, the competition for ground water has reached the critical stage. This is significant, particularly as orchards reach the fully mature rate of water use. Surface water is supplied to parts of the study area by Orange Cove and Tri-Valley Irrigation Districts. High costs have limited the extension of this resource.

State Highway 180, a major highway between Fresno and Sequoia-Kings Canyon National Parks, passes through the middle of the area. The highway is the major link between the valley and coastal cities and the communities of Squaw Valley, Klingans, Dunlap, Miramonte and Pinehurst. Within the study area, Cove and Crawford avenues are paved county roads which give access to the cities of Reedley and Orange Cove. Other county roads give access to all parts of the watershed floor, regardless of weather conditions. The rangeland is essentially roadless for vehicular access.

There are no perennial streams in the study area. Runoff reaches the Kings River through the Alta Irrigation District Canal and Ditch System, about 15 miles downstream.

CHAPTER III - RESOURCE CAPABILITY INVENTORIES

BASIC DATA

In order to access the effect of soil erosion and sedimentation on water quality at Citrus Cove, it was necessary to first estimate the amount of sediment that is expected to be produced annually and delivered to the drainage system. Some of the information used in the calculations that predicts erosion rates and sediment yield was already known for the entire study area from previous surveys[1]. Others needed to be determined from field measurement or evaluation.

Because of the time and manpower limitations the field work had to be restricted to a portion of the study area, covering about 5 percent of the total. The convenient size of the sampling sites was chosen to be ten acres. Thirty-three sample sites were selected.

This report contains orderly assemblages of already available data in the forms of maps and tables. The data is composed of numerical values when appropriate and areal distributions of parameters (assigned qualitative values used to describe particular qualities of soil). Both are used in the selection of sites to ensure as representative a sampling as possible. The various parameters from which the data was assembled are presented in the following section, together with a brief commentary on their role and purpose, relative to the overall study.

The basis for all map preparation was the current U.S.G.S. Quadrangle (7½ minutes) (1:24,000 scale) topographic maps. Map measurements were made by planimetering and scaling directly from reproductions. Aerial photography was used for interpretative use in making the land use map, determining gullies and landslide areas.

One of the methods of using data which has been applied throughout the survey is to extrapolate data and to apply it to the entire study area.

[1]Refers to reference section on page 25. Throughout the report, the number in parentheses will represent the number of the reference. This footnote refers to reference (2).

Land Use

Because an association exists between land use characteristics and rates of erosion, land use was selected as a guiding factor for selecting sampling sites. Distribution of those sites according to land use provides for a simple and rational means of using on-site measured data to be representative over an entire study area.

The different land uses in the area are represented on Map 1. Maps were used to determine specific areas in acres associated with each land use. The various land uses in the study area, together with their descriptions, are listed in Appendix A.

The predominant land use in the Citrus Cove pilot study area is rangeland, consisting of 2,680 acres or 52 percent of the study area. Other major land uses include various irrigated tree crops covering 1,860 acres or 35 percent of the study area. Navel oranges are the predominant tree crop in the study area. Refer to Table 1 and Map 1 for amounts and locations.

Soil Erodibility Factor (K)

The soil erodibility or K factor is a measure of the susceptibility of a given soil to erosion by rainfall. All the soils in the Citrus Cove study area have already been mapped and assigned K factor values (2). Table 2 shows the soils in the area and their assigned K and T factors. The soil survey map of Eastern Fresno area was used as the basis for preparing a new K factor map, specifically for the Citrus Cove study area (Map 2). This map was able to serve the dual purpose of providing the area's K values for the estimation of erosion rates by rainfall and in guiding the selection of sampling sites.

Areas associated with each class of K value were measured from the map and listed in Table 3. Table 3 shows that approximately 50 percent of the study area has soils with a moderate sheet and rill erosion potential. Of this, 1,290 acres or 25 percent of the study area has a K factor of 0.24 and 1,200 acres or 24 percent has a K factor of 0.28 (see page 12).

Table 1. LAND USE, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Land Use	Pilot Study Area (Acres)	(Ha)	% of Total
Non-Irrigated Grazing & Rangeland	2680	1090	52.0
Irrigated Grazing	70	30	1.5
Non-Irrigated Wheat	220	90	4.5
Irrigated Sub-Tropical Fruits			
Avocados	350	140	7.0
Lemons	340	140	7.0
Navel Oranges	810	330	15.5
Olives	60	20	1.0
Other	140	60	2.5
Irrigated Deciduous Fruits and Nuts			
Almonds	30	10	0.5
Peaches, Freestone	60	20	1.0
Pistachios	40	20	0.5
Plums	30	10	0.5
Commercial	20	10	0.5
Transportation	140	60	2.5
Other	180	70	3.5
TOTALS	5170	2100	100.0
TOTAL	8.1 Sq Mi	21 Sq Km	

Table 2. SOIL SURVEY INTERPRETATIONS OF EROSION FACTORS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Map Symbol	Soil Name	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor
An	Alamo clay	0.15	5
Cr	Chino loam	0.28	5
CuC	Cibo clay, 3 to 15 percent slopes	0.28	1
CwD	Cibo extremely rocky clay, 3 to 30 percent slopes	0.28	1
CwE	Cibo extremely rocky clay, 30 to 45 percent slopes	0.28	1
CzaB	Cometa sandy loam, 3 to 9 percent slopes	0.24	2
CzbB	Cometa loam, 2 to 9 percent slopes	0.32	2
FaB	Fallbrook sandy loam, 3 to 9 percent slopes	0.32	2
FaC	Fallbrook sandy loam, 9 to 15 percent slopes	0.32	2
FaD	Fallbrook sandy loam, 15 to 30 percent slopes	0.32	2
FcD	Fallbrook very rocky sandy loam, 3 to 30 percent slopes	0.28	2
FdF	Fallbrook very rocky sandy loam, shallow, 30 to 70 percent slopes	0.28	2
GrF	Granitic rock land	0.28	5
GtB	Greenfield sandy loam, 3 to 9 percent slopes	0.15	5
Hc	Hanford sandy loam	0.24	5
Hd	Hanford sandy loam, benches	0.24	5
Hu	Hildreth clay	0.26	5
Md	Madera loam, saline-alkali	0.28	2
PxA	Porterville clay, 0 to 3 percent slopes	0.24	5
Rc	Ramona Loam	0.37	5
SeA	San Joaquin loam, 0 to 3 percent slopes	0.37	2
SkB	Sesame sandy loam, 3 to 9 percent slopes	0.28	2

Table 2. SOIL SURVEY INTERPRETATIONS OF EROSION FACTORS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978 - CONTINUED

Map Symbol	Soil Name	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor
SlB	Sesame loam, 3 to 9 percent slopes	0.37	2
TlD	Tivy very rocky loam, 3 to 30 percent slopes	0.32	1
VaA	Visalia sandy loam, 0 to 3 percent slopes	0.20	5
VkD	Vista very rocky coarse sandy loam, 3 to 30 percent slopes	0.24	2
VkE	Vista very rocky coarse sandy loam 30 to 45 percent slopes	0.24	2
VlF	Vista very rocky coarse sandy loam, 30 to 70 percent slopes	0.24	1
VmD	Vista extremely rocky coarse sandy loam, 3 to 30 percent slopes	0.20	2
VsF	Vista-Fallbrook extremely rocky coarse sandy loams, 30 to 70 percent slopes	0.20	2

Rainfall (Rt) Factor

As rainfall provides the major force from which soil erosion results, a measure of it must be included in any analysis of the potential for soil erosion. R factors have been developed which indicate the effect of rainfall in a given area on the potential soil erosion rates. This factor takes into account not only total amounts of rainfall, but also the intensity of the rainfall and the seasonal distribution of storms. In areas where snowmelt producing runoff contributes a significant part to erosion, the overall effect is represented by the combined factor (Rt).

Rainfall Frequency Maps issued by the National Oceanic and Atmospheric Administration were utilized to portray isopluvials (a line on a map connecting points of equal rainfall amounts) of 2 year, 6 hour rainfall on the study area maps(1). The data on these maps was next converted into Rt values by the method described in Guides for Erosion and Sediment Control in California(3). Areas associated with the ranges of Rt values in the study area were measured on Map 3 and listed on Table 4.

Table 4 shows that approximately 80 percent of the study area is described by an Rt in the range of 15 to 25. Of this, 2,160 acres or 42 percent of the study area has an Rt of 15 to 20, and 2,070 acres or 40 percent has an Rt of 20 to 25.

Slope Steepness

Slope is another factor that influences the potential for a given area to experience soil erosion. As the slope of the land affects the tendency for a given amount of soil to move downward by force of gravity, it is a factor that influences rates of water runoff and, hence, rates of erosion and sedimentation.

Available slope steepness data for the entire study area was assembled from past soil surveys and represented on Map 4, which identifies not only soil type, but a slope class associated with all areas. The total area was then divided into segments according to the slope steepness classes shown in Appendix D. Each segment was labeled with the associated code symbol.

Table 5 shows the major slope class to be 0 to 3 percent, consisting of 1,780 acres or 35 percent of the study area. Other existing slopes range up to and exceed 50 percent. The majority of crops are grown on areas having slopes of less than 9 percent. See Table 5 and Map 4 for further information on slopes and acreage amounts.

Table 3. SOIL ERODIBILITY (K) FACTOR AREAS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Soil Erodibility (K) Factor	Pilot Study Area (Acres)	(Ha)	% of Total
0.15	320	130	6.0
0.20	730	300	14.0
0.24	1290	520	25.0
0.26	170	70	3.5
0.28	1200	490	23.5
0.32	570	230	11.0
0.37	880	360	17.0
Granite	10	Less than 5	Less than 0.25
TOTALS	5170	2100	100.0

Table 4. RAINFALL (Rt) FACTOR AREAS, CITRUS COVE PILOT STUDY AREA, FRESNO COUNTY, 1978

Rainfall Factor (Rt)	Pilot Study Area (Acres)	(Ha)	% of Total
10-15	40	20	1.0
15-20	2160	870	42.0
20-25	2070	840	40.0
25-30	810	330	15.5
30-40	90	40	1.5
TOTALS	5170	2100	100.0

Soil Loss Tolerance Factor (T)

Soil loss tolerance (T), sometimes called permissible soil loss, is the maximum rate of soil erosion (whether from rainfall or wind) that will permit a high level of crop productivity to be sustained economically and indefinitely. T factors of 1 through 5 are used.

The numbers represent the permissible tons of soil loss per year. The T factor is used in the soil loss prediction equations for rainfall and for wind erosion. The same T factors are used for each equation, and are not additive if both rainfall erosion and wind erosion occur on the same soil.

T factor has a relationship to the rooting depths of a soil and, therefore, is a factor in determining some conservation practices for a given land use.

As a first step, existing data from the Eastern Fresno Area Soil Survey, 1971, was used to prepare a T factor map. Measurement of areas having the same value were made.

Table 6 shows that the majority of the soils (3,600 acres or 70 percent of the study area) has a soil loss tolerance of two tons/acre/year. See Table 6 and Map 5 for further information on amounts and locations.

Vegetal Cover

It is an indicator of potential erosion, but because of the difficulty in describing it numerically, it cannot be used directly in arriving at estimates by computational methods. Its evaluation is descriptive as shown in Appendix F and particularly important in non-crop lands such as range. In general, areas of different cover-types can be delineated on a map, which in turn is used to extrapolate data from sampling sites to the entire area.

Table 7 shows that the major vegetal cover type, excluding the cropped area, is hardwoods and grass, consisting of 1,680 acres or 33 percent of the study area. Refer to Table 7 and Map 6 for additional amounts and locations.

Table 5. SLOPE AREAS, CITRUS COVE 208 PILOT STUDY AREA, FRESNO COUNTY, 1978

Slopes %	Pilot Study Area (Acres)	(Ha.)	% of Total
0-3	1780	720	34.5
3-9	860	350	16.5
9-15	380	150	7.5
15-30	460	190	9.0
30-50	1090	440	21.0
50 +	600	240	11.5
TOTALS	5170	2100	100.0

Table 6. ALLOWABLE SOIL LOSS TOLERANCE (T) FACTOR AREAS, CITRUS COVE PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Loss Tolerance (T) Factor (tons/acre/year)	Pilot Study Area (Acres)	(Ha.)	% of Total
1	290	120	5.5
2	3600	1460	70.0
5	1270	520	24.5
Granite	10	Less than 5	Less than 0.25
TOTALS	5170	2100	100.0

Table 7. VEGETAL COVER TYPES, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Vegetal Cover Types	Pilot Study Area (Acres)	(Ha)	% of Total
Grasses and Forbs	1,050	430	20.5
Hardwoods and Grass	1,680	680	32.5
Other	2,430	990	47.0
TOTALS	5,170	2,100	100.0

Table 8. STREAM LENGTHS BY STREAM ORDER, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Stream Order	Length (Miles)	(Km)
2	8	13
3	Less than 0.5	1
TOTALS	8	14
Drainage Ditches	8	13

Table 9. STREAM DENSITY BY STREAM ORDER, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Stream Order	Density (Mi/Sq Mi)	(Km/Sq Km)
2	1.0	0.6
3	0.1	Less than 0.05
TOTALS	1.1	0.6

Stream Orders

Stream ordering provides a basis by which drainage-net characteristics can be related to each other and to hydrologic and erosional processes. The stream orders inventory was taken with two objectives in mind: 1. to calculate the total length of streams in the pilot area and 2. to compute the stream densities (in miles of stream per square mile of land) in each of the watersheds. It is theorized that the greater the stream density in any one area, the greater the sedimentation hazard may be. This information is useful in determining sediment sources and the significance of a given area as to its sediment contribution. A stream order map was prepared for the Citrus Cove study area (Map 7). Data on the stream length and stream density by stream orders measured are shown on Tables 8 and 9 respectively.

The results indicate that eight miles of streams still exist in the study area. These streams are all found in the upland portions of the study area, and they are all second order. This order suggests that all streams are in close proximity to their watershed, and there is no merging of streams together at a given point. The streams in the lower sections of the study area have been filled and orchards have been planted. Drainage ditches have replaced the natural streams in this section. See Tables 8 and 9 and Map 7 for further information on orders and locations.

Transportation Facilities

Water induced erosion within the construction and maintenance boundaries of transportation facilities (such as, highways, roads, etc.) is the result of different processes, other than those causing erosion on agricultural lands. For this reason this type of erosion is being treated separately here.

In order to help the selection of sampling sites on which actual measurement of erosion could be made, and the generalization of results from such measurements, a transportation facilities map was prepared (see Map 8).

Table 10 shows that 14 miles of roadway are present. Of these roads, five miles are State maintained secondary roads and five miles are county maintained light duty roads. Refer to Table 10 and Map 8 for further information. Approximately 30 miles of privately maintained unimproved roads exist in the study area as farm roads between fields. As these do not contribute significantly to soil erosion over the entire study area, they are deleted from this map.

Table 10. TRANSPORTATION FACILITIES, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Transportation Facility	Length (Miles)	(Km)
State Maintained:		
Secondary Road	5	8
City/County Maintained:		
Secondary Road	1	2
Light Duty Road	5	8
Privately Maintained:		
Light Duty Road	3	5
Unimproved Road	Less than 0.5	1
Railroad:		
Single Track	Less than 0.5	1
TOTALS	14	25

SELECTION OF SAMPLE SITES

Sheet and rill erosion is the most predominant type of erosion expected in the study area. Sheet erosion describes the removal of a fairly uniform layer of soil from the land surface by runoff water. Rill erosion is a process in which numerous small channels of only several inches in depth are formed. Because it is very difficult to survey the entire study area for soil erosion, it was decided to use a system of representative sampling. Based on on-site measurements, this system would describe the extent of any problem. The data derived from these sample sites will later be projected over the entire study area. Five percent of the total study area was determined to be an adequate sample size for describing sheet and rill erosion.

Within this total study area of 5,170 acres, 260 acres would be sampled. Using individual ten-acre sample sites, 26 sample sites would be required. In actuality, a total of 33 sample sites were selected, the additional sample sites being desirable for more complete understanding of soil erosion problems on certain select land uses. This distribution took into account the variation in areal extent of each of the factors. For example, avocado groves comprise 400 acres of the study area. A 5 percent coverage of this would require a sample area of 20 acres (5% of 400 = 20). Therefore, at least two sample sites of ten acres each would be indicated. The sample sites were distributed throughout the study area to maximize coverage of factors in the parameters previously discussed.

Tables 12 through 16 document the proportional distribution of sample sites in relation to each factor under the parameters of land use, K factor, T factor, Rt factor, slope class and vegetal cover type. For each factor listed, 5 percent of its areal extent, number of samples, area of sample, and percent of area sampled relative to the 5 percent goal are listed (e.g., K factor = 0.28, 5 percent of area = 60 acres, number of samples = 6, area sampled = 60 acres, percent relative to 5 percent goal = 100 percent). This last figure is a measure of the extent to which the 5 percent "goal" is attained.

Table 17 presents each sample site individually and lists K factor, T factor, Rt factor, slope class and vegetal cover type associated with it. Map 9 indicates the position of each of the sample sites.

Table 11. DISTRIBUTION OF SAMPLE SITES BY LAND-USE, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Land Use	5% of Land-Use Area (Acres)	Number of Samples Selected	Area of Samples (Acres)	% of Area Sampled Relating to 5% of Area
Non-Irrigated Grazing & Rangeland	130	9	90	70
Non-Irrigated Wheat	10	3	30	300
Irrigated Grazing	a	1	10	b
Irrigated Sub-Tropical Fruits				
Avocados	20	4	40	200
Navel Oranges	40	6	60	150
Lemons	20	4	40	200
Olives	a	1	10	b
Other	10	2	20	200
Irrigated Deciduous Fruits & Nuts				
Almonds	a	1	10	b
Peaches (Free-stone)	a	1	10	b
Pistachios	a	1	10	b
Plums	a	1	10	b
Commercial	a	0	0	0
Transportation	10	c	140	1400
Other	10	0	0	0
TOTALS	240	34	340	Greater than 130%

a = Area of 5.0 acres or less.

b = Greater than 200%.

c = All of the land-use area will be sampled.

Table 12. DISTRIBUTION OF SAMPLE SITES BY SOIL ERODIBILITY (K) FACTORS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Soil Erodibility Factor	5% of Area (Acres)	Number of Samples Selected	Area of Samples (Acres)	% of Area Sampled Relating to 5% of Area
0.15	20	3	30	150
0.20	40	3	30	80
0.24	60	6	60	100
0.26	10	1	10	100
0.28	60	6	60	100
0.32	30	6	60	200
0.37	40	8	80	200
Granite	--	--	--	--
TOTALS	260	33	330	130

Table 13. DISTRIBUTION OF SAMPLE SITES BY RAINFALL (Rt) FACTORS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Rainfall Factors (Rt)	5% of Area (Acre)	Number of Samples Selected	Area of Samples (Acres)	% of Area Sampled Relating to 5% of Area
10-15	a	1	10	b
15-20	110	18	180	160
20-25	100	12	120	120
25-30	40	2	20	50
30-40	a	0	0	0
TOTALS	250	33	330	130

Table 14. DISTRIBUTION OF SAMPLE SITES BY SLOPING AREA, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Slope	5% of Area (Acres)	Number of Samples Selected	Area Area of Samples	% of Area Sampled Relating to 5% of Area
0-3	90	14	140	160
3-9	40	10	100	250
9-15	20	2	20	100
15-30	20	1	10	50
30-50	50	3	30	60
50+	30	3	30	100
TOTALS	250	33	330	130

a = Area of 5 acres or less.
b = Greater than 200.

Table 15. DISTRIBUTION OF SAMPLE SITES BY SOIL LOSS TOLERANCE (T) FACTORS, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Soil Loss Tolerance Factor	5% of Area (Acres)	Number of Samples Selected	Area of Samples (Acres)	% of Area Sampled Relating to 5% of Area
1	10	1	10	100
2	180	23	230	
5	60	9	90	150
Granite	--	--	--	--
TOTALS	250	33	330	130

Table 16. DISTRIBUTION OF SAMPLE SITES BY VEGETAL COVER TYPES, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Vegetal Cover Type	5% of Area (Acres)	Number of Samples Selected	Area of Samples (Acres)	% of Area Sampled Relating to 5% of Area
Grasses and Forbs	50	4	40	80
Hardwoods and Grass	80	5	50	60
Other	120	24	240	200
TOTALS	250	33	330	130

Table 17. SAMPLE SITES, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Sample Site	Land Use	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor	Rainfall (Rt) Factor	Slopes (%)	Vegetal Cover Type
1	Irrigated Grazing	0.32	2	10-15	3-9	Other
2	Non-Irrigated Wheat	0.32	2	15-20	3-9	Other
3	Irrigated Oranges	0.15	5	15-20	0-3	Other
4	Irrigated Oranges	0.26	5	15-20	0-3	Other
5	Irrigated Olives	0.37	2	15-20	0-3	Other
6	Non-Irrigated Wheat	0.15	5	15-20	0-3	Other
7	Irrigated Oranges	0.37	2	15-20	0-3	Other
8	Non-Irrigated Wheat	0.37	2	20-25	0-3	Other
9	Irrigated Almonds	0.37	2	20-35	0-3	Other
10	Non-Irrigated Grazing	0.20	2	20-25	30-50	Grass & Forbs
11	Irrigated Avocados	0.37	2	20-25	9-15	Other
12	Irrigated Plums	0.37	2	20-25	0-3	Other
13	Irrigated Oranges	0.37	2	20-25	0-3	Other
14	Irrigated Avocados	0.32	2	15-20	3-9	Other
15	Irrigated Oranges	0.32	2	15-20	3-9	Other
16	Irrigated Peaches	0.24	5	15-20	0-3	Other
17	Irrigated Oranges	0.37	5	15-20	0-3	Other
18	Non-Irrigated Grazing	0.20	2	20-25	30-50	Grass & Forbs
19	Non-Irrigated Grazing	0.20	2	20-25	9-15	Hardwoods & Grass
20	Non-Irrigated Grazing	0.20	2	20-25	50+	Hardwoods & Grass

Table 17. SAMPLE SITES, CITRUS COVE "208" PILOT STUDY AREA, FRESNO COUNTY, 1978 - CONTINUED

Sample Site	Land Use	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor	Rainfall (Rt) Factor	Slopes (%)	Vegetal Cover Type
21	Irrigated Avocados	0.28	2	15-20	3-9	Other
22	Irrigated Lemons	0.28	2	15-20	3-9	Other
23	Irrigated Pistachios	0.28	5	15-20	0-3	Other
24	Non-Irrigated Grazing	0.32	2	15-20	3-9	Grass & Forbs
25	Irrigated Lemons	0.32	2	15-20	3-9	Other
26	Irrigated Citrus, Other	0.28	5	15-20	0-3	Other
27	Irrigated Lemons	0.15	5	15-20	3-9	Other
28	Non-Irrigated Grazing	0.28	2	20-25	50+	Grass & Forbs
29	Irrigated Lemons	0.24	2	20-25	3-9	Other
30	Irrigated Avocados	0.24	5	15-20	0-3	Other
31	Non-Irrigated Grazing	0.28	2	25-30	30-50	Hardwoods & Grass
32	Non-Irrigated Grazing	0.24	2	20-25	15-30	Hardwoods & Grass
33	Non-Irrigated Grazing	0.24	1	34	50+	Hardwoods & Grass

REFERENCES

1. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, (U. S. Department of Commerce), Precipitation Frequency Maps for California. December 1972.

2. SOIL CONSERVATION SERVICE, (U. S. Department of Agriculture), Soil Survey of Eastern Fresno Area, California. October 1971.

3. SOIL CONSERVATION SERVICE, (U. S. Department of Agriculture), Guides for Erosion and Sediment Control in California. January 1975.

APPENDICES

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 Screen 1 of 2      ¶
⊧AGL
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 ⊧ 6 090       ǂb  ¶
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 ⊧ 8 110 10   United States. ǂb Soil Conservation Service. ǂb Fresno Field
Office. ¶
 ⊧ 9 245 10   Resource capabilities affecting sedimentation mini-report : ǂb
Molar Flats pilot study area Fresno County, California / ǂc prepared by the
Fresno Field Office, USDA Soil Conservation Service and U.S. Department of
Agriculture River Basin Planning Staff ; in cooperation with Navelencia
Resource Conservation District. ¶
 ⊧10 260 0    Fresno, CA : ǂb The Field Office ; ǂa Davis, CA : ǂb The Planning
Staff, ǂc [1978] ¶

 Screen 2 of 2      ¶
 ⊧11 300      34 p., [9] folded leaves of plates : ǂb maps ; ǂc 27 cm. ¶
 ⊧12 500      "July 1978." ¶
 ⊧13 504      Includes bibliographical references (p. 24). ¶
 ⊧14 650  0   Sedimentation and deposition ǂz California ǂz Fresno County. ¶
 ⊧15 710 20   USDA River Basin Planning Staff. ¶
 ⊧16 710 20   Navelencia Resource Conservation District. ¶
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APPENDIX A

LAND USE MAP LEGEND

IG. Irrigated Grazing. Irrigated land used primarily for the production of planted forage plants harvested by livestock. Includes partially irrigated land that receives at least half of the applied water requirement for that pasture.

NG. Non-Irrigated Grazing-Rangeland. Non-irrigated land used primarily for the production of non-planted forage plants grazed by livestock and big game animals and which does not produce wood commodities.

NF. Non-Irrigated Field Crops. Non-irrigated land used primarily for the production of adapted close-growing field crops for harvest, alone or in association with sod crops. Includes partially irrigated land that receives less than half of the applied water requirement for that crop.

Wheat.

ID. Irrigated Deciduous Fruits and Nuts. Irrigated land used primarily for the production of deciduous fruits and nuts for harvest. Includes partially irrigated land that receives at least half of the applied water requirement for that crop.

Peaches, freestone.
Pistachios.
Plums.

IS. Irrigated Subtropical Fruits. Irrigated land used primarily for the production of subtropical fruits for harvest. Includes partially irrigated land that receives at least half of the applied water requirement for that crop.

Avocados.
Lemons.
Olives.
Oranges, navel.
Other.

IV. Irrigated Vineyards. Irrigated land used primarily for the production of grapes and bushberries for harvest. Includes partially irrigated land that receives at least half of the applied water requirement for that crop.

CI. Commercial/Industrial. Land used primarily for buying, selling, and processing goods and services, and including sites for stores, factories, shopping centers, and industrial parks, together with necessary adjacent facilities such as underground and surface utilities, access streets and alleys, and other servicing structures, appurtenances, and measures.

TS. Transportation Services. Land used primarily for highways, roads, beltways, railroads, utility rights-of-way, airports, and other transportation facilities, together with necessary adjacent facilities such as approaches, underground and surface utilization, and other servicing structures, appurtenances, and measures.

W. Water. Includes permanent inland water surface such as lakes, ponds, and reservoirs having 40 acres or more of area; streams, sloughs; estuaries; and canals 1/8 of a statute mile or more in width. Smaller bodies of water are classified as land.

X. Other. Land not classified in any of the above categories.

APPENDIX B

SOIL ERODIBILITY (K) FACTOR MAP LEGEND

Soil areas judged to have soil erodibility factor (K) values:

.15	Of at least .13 but not more than .15
.17	Of at least .16 but not more than .18
.20	Of at least .19 but not more than .21
.24	Of at least .22 but not more than .25
.28	Of at least .26 but not more than .29
.32	Of at least .30 but not more than .34
.37	Of at least .35 but not more than .39
_____	Watershed Boundary
(blank)	Miscellaneous areas not classified

APPENDIX C

SOIL LOSS TOLERANCE (T) FACTOR MAP LEGEND

Soil areas judged to have a soil loss tolerance of:

1	1 ton per acre per year
2	2 tons per acre per year
3	3 tons per acre per year
4	4 tons per acre per year
5	5 tons per acre per year
W	Water
_____	Watershed Boundary
(blank)	Miscellaneous areas not classified

APPENDIX D

RAINFALL (Rt) FACTOR MAP LEGEND

Areas with mean annual rainfall intensity factor (Rt) values:

10	Not exceeding 12
15	Of at least 13 but not more than 17
20	Of at least 18 but not more than 22
25	Of at least 23 but not more than 27
30	Of at least 28 but not more than 34
40	Of at least 35 but not more than 34
50	Of at least 45 but not more than 54
60	Of at least 55 but not more than 64
70	Of at least 65 but not more than 74
80	Of at least 75 but not more than 84
90	Of at least 85 but not more than 94
100	Of 95 or greater
16	Average Annual Precipitation
W	Water
	Watershed Boundary

APPENDIX E

SLOPE MAP LEGEND

0 - 3 Percent. Areas in which the average slope of the land is not more than 3 percent above horizontal. Includes not more than 10 percent of areas with average slopes greater than 3 percent.

3 - 9 Percent. Areas in which the average slope of the land ranges from 3 to 9 percent above horizontal. Includes not more than 10 percent of areas with average slopes less than 3 percent.

9 - 15 Percent. Areas in which the average slope of the land ranges from 9 to 15 percent above horizontal. Includes not more than 10 percent of areas with average slopes less than 9 percent and greater than 15 percent.

15 - 30 Percent. Areas in which the average slope of the land ranges from 15 to 30 percent above horizontal. Includes not more than 10 percent of areas with average slopes less than 15 percent and greater than 30 percent.

30 - 50 Percent. Areas in which average slope of the land ranges from 30 to 50 percent above the horizontal. Includes not more than 20 percent of areas with average slopes less than 30 percent and greater than 50 percent.

Above 50 Percent. Areas in which the average slope of the land is greater than 50 percent above horizontal. Includes not more than 20 percent of areas with average slopes less than 50 percent.

APPENDIX F

VEGETAL COVER TYPES MAP LEGEND

GF. Grass and Forbs. Mountain meadows and non-irrigated areas in which grasses and forbs cover more than 50 percent of the ground space or more space than the crown canopy of shrubs and not classified Coniferous Forest, Hardwood Forest, Chaparral, and Mountain Brush, Pinyon-Juniper, or Hardwoods and Grass. Annual species include California wild oats, bromes, fescuess, clover, California bur-clover, vetches and filarees. Perennial species include needlegrasses, oatgrasses, Idaho fescue, melicgrasses, hairgrasses, wild-rye grasses, wheatgrasses, bluegrasses, desert saltgrass, alkali sacaton, squirreltail and Western yarrow (Achillea).

HG. Hardwoods and Grass. Areas in which the crown canopy of broadleaved tree species cover 20 to 50 percent of the ground space with grass and forbs covering at least 20 percent of the ground space and not classified Coniferous Forest, Hardwood Forest or Chaparral and Mountain Brush. Species include principally oaks, grasses and forbs.

X. Other. Areas which are not classified in any of the above categories. Examples are Cultivated and Pasture, Urban-Industrial, and Barren areas.

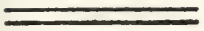
APPENDIX G

STREAM ORDER MAP LEGEND

2	Second order stream reach is the uppermost stream reach delineated by a blue line on the standard U. S. Geological Survey 1:24,000 scale topographic quadrangle map or, if not available, then on a 1:62,500 scale quadrangle map that continues downstream to the junction with the next stream.
3	Third order stream reach beginning at the junction of two second order streams and continuing downstream to the junction with the next third order stream.
4	Fourth order stream reach beginning at the junction of two third order streams and continuing downstream to the junction with the next fourth order stream.
5	Fifth order stream reach beginning at the junction of two fourth order streams and continuing downstream to the junction with the next fifth order stream.
6	Sixth order stream reach beginning at the junction of two fifth order streams and continuing downstream to the junction with the next sixth order stream.
7	Seventh order stream reach beginning at the junction of two sixth order streams and continuing downstream to the junction with the next seventh order stream.
W	Water
~.~	Perennial stream that flows throughout the year.
~...~	Intermittent stream that flows during wet seasons and is dry during dry seasons.
———	Watershed Boundary

APPENDIX H

TRANSPORTATION FACILITIES MAP LEGEND



Divided primary or heavy duty road with all weather, hard surface. Includes Federal and state highways maintained by the state.

Primary or heavy duty road with all weather, hard surface. Includes Federal and state highways maintained by the state.

Secondary or medium duty road with all weather, hard surface. Includes Federal and state roads maintained by the state.

Light duty, all weather road with hard or improved surface.

Unimproved dirt surface road.

Road maintained by a Federal agency.

Road maintained by the state.

Road maintained by a city or county.

Trail

Railroad, single track

Railroad, multiple track

Landplane airport (improved)

Landing area or landing strip (unimproved)

W

Water

Watershed Boundary

APPENDIX I

ROUNDING DATA AND METRIC CONVERSION FACTORS

Round all data on tables to nearest:

10	Acres
10	Hectares
1	Mile
1	Kilometer
0.1	Mile/Square Mile
0.1	Kilometer/Square Kilometer
0.1	Ton (English)/Acre
0.1	Ton (Metric)/Hectare
10	Tons (English)/Square Mile
10	Tons (Metric)/Square Kilometer

Rules for rounding (6):

If number is below middle value, then round down.

Examples: 1.49 miles to 1 mile
14.99 acres to 10 acres

If number is above middle value, then round up.

Examples: 1.51 miles to 2 miles
15.01 acres to 20 acres

If number is the middle value, then round to next even number.

Examples: 1.5 miles to 2 miles
2.5 miles to 2 miles
15.0 acres to 20 acres
25.0 acres to 20 acres

Factors for converting data on tables to metric units:

(0.4047) (Acres) = Hectares

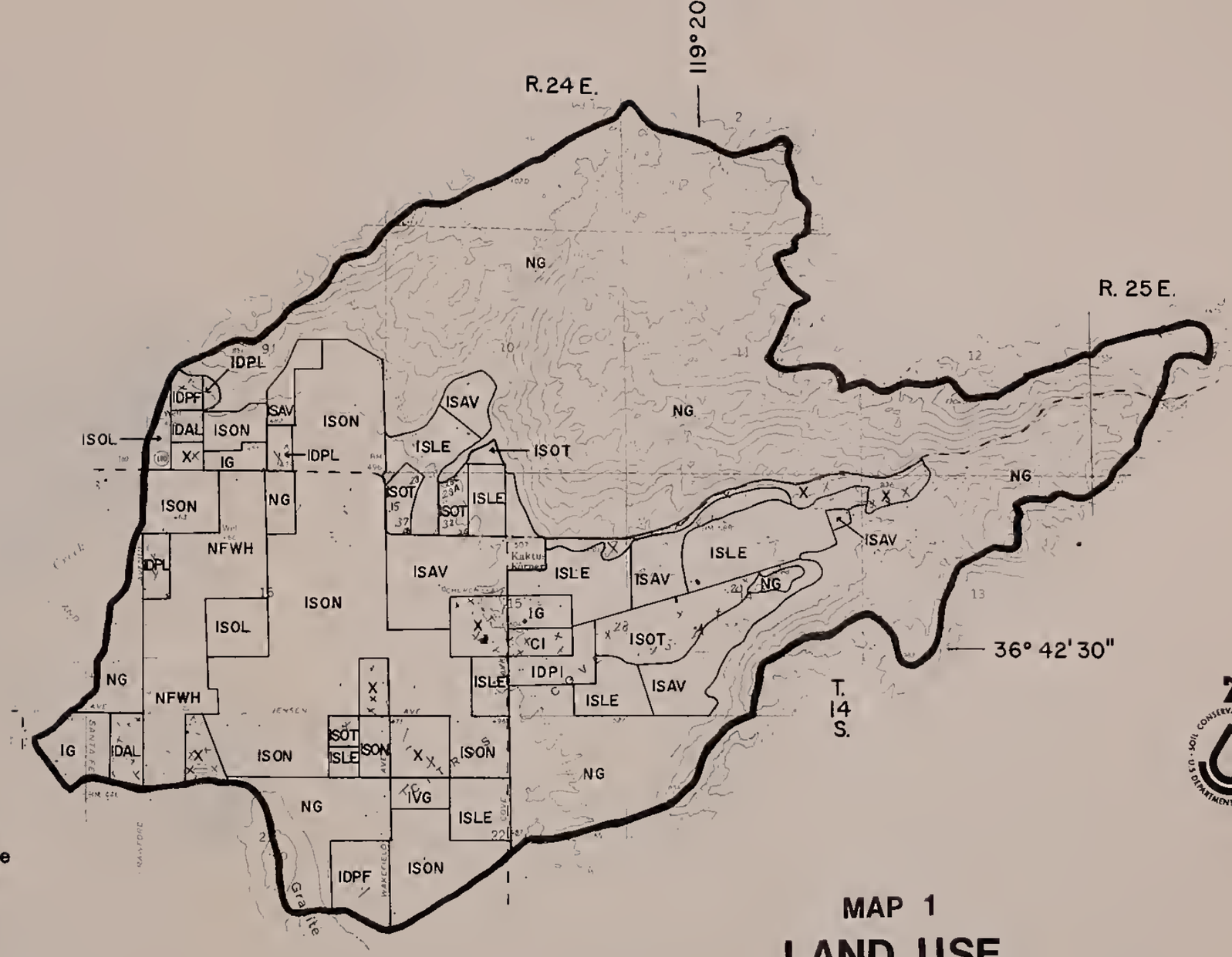
(1.609) (Miles) = Kilometers

(0.6214) (Miles/Square Mile) = Kilometers/Square Kilometer

(2.24) (Tons (E)/Acre) = Tons (M)/Hectare

(0.35) (Tons (E)/Square Mile) = Tons (M)/Square Kilometer

MAPS



LEGEND

CI	Commercial/industrial
IDAL	Irrigated Almonds
IDPF	Irrigated Peaches, Freestone
IDPL	Irrigated Plums
IG	Irrigated Grazing
ISAV	Irrigated Avacados
ISLE	Irrigated Lemons
ISOL	Irrigated Olives
ISON	Irrigated Oranges, Navel
ISOT	Irrigated Fruit, Other
IVG	Irrigated Grapes
NFWH	Non-Irrigated Wheat
NG	Non-Irrigated Grazing
X	Other
———	Watershed Boundary

MAP 1
LAND USE
CITRUS COVE
208 PILOT STUDY AREA

FRESNO COUNTY
APRIL, 1978

0.5 0 MILES

0.5 0 KILOMETERS

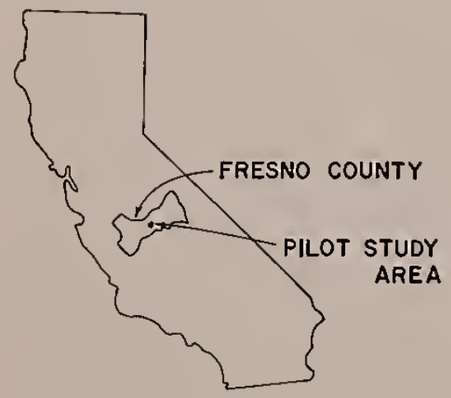
N

U.S. DEPARTMENT of AGRICULTURE · SOIL CONSERVATION SERVICE

LEGEND

Soils judged to have soil erodibility factor (K) values:

- .15 Of at least .13 but not more than .15
- .20 Of at least .19 but not more than 21
- .24 Of at leest .22 but not more than .25
- .28 Of at least .26 but not more then .29
- .32 Of at leest 30 but not more than .34
- .37 Of at least .35 but not more then .39
- ☐ Miscelleneous Areas not classified
- — Watershed Boundary



MAP 2
"K" FACTOR MAP
CITRUS COVE
208 PILOT STUDY AREA
FRESNO COUNTY
JANUARY, 1978

0.5 0 MILES

0.5 0 KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE ·

R. 24 E.

119° 20' 00"

R. 25 E.

36° 42' 30"

T. 14 S.

Kaktus Körner

Granite

LEGEND

Soils judged to have a soil-loss tolerance:

- 1 Of 1 ton per acre per year
- 2 Of 2 tons per acre per year
- 5 Of 5 tons per acre per year
- ☐ Miscellaneous areas not classified

—— Watershed Boundary

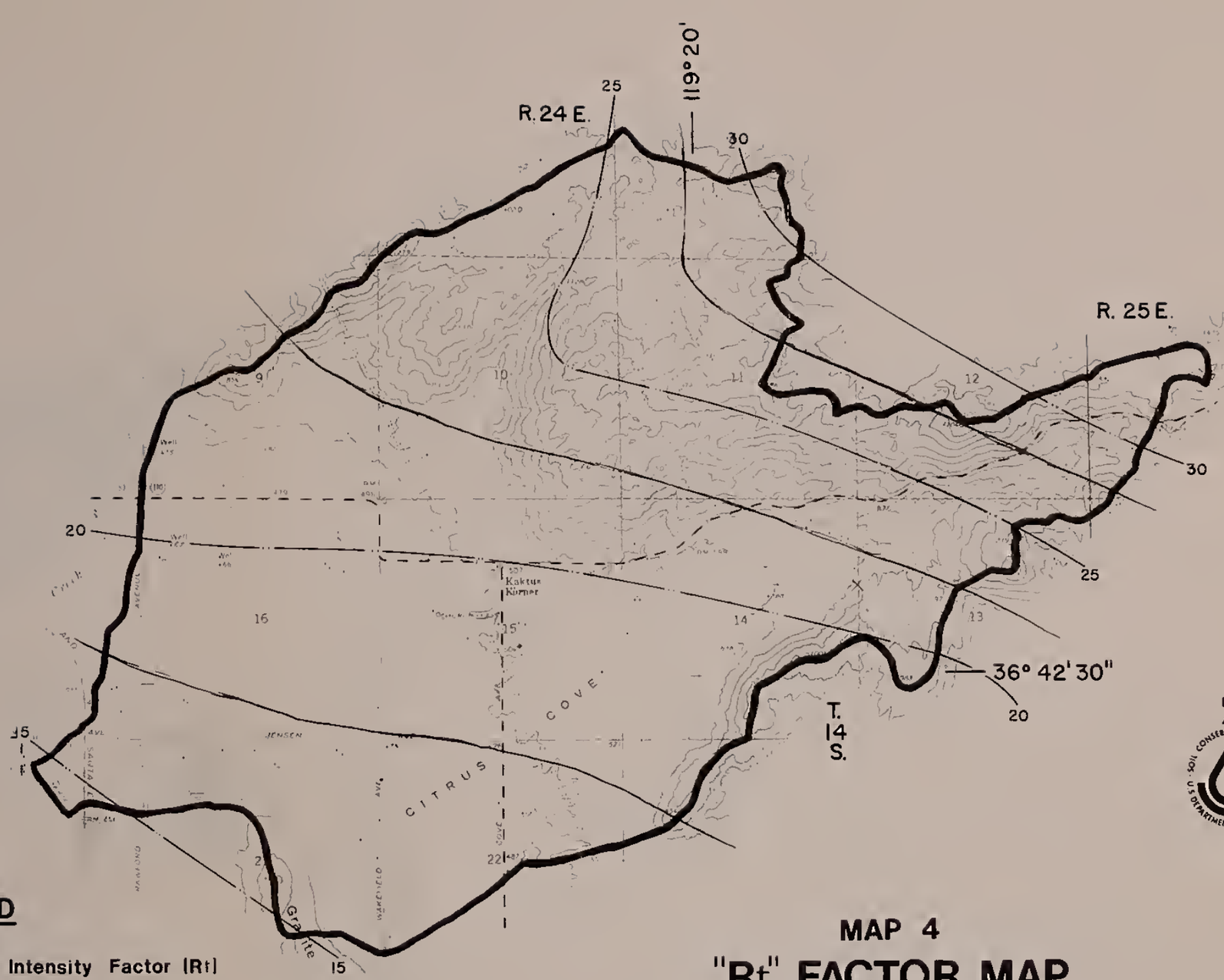
MAP 3
"T" FACTOR MAP
CITRUS COVE
208 PILOT STUDY AREA
FRESNO COUNTY
JANUARY, 1978

0.5 0 MILES

0.5 0 KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE ·



LEGEND

Mean Annual Rainfall Intensity Factor (Rt) Values:

- 15 — Of at least 13 but not more than 17
- 20 — Of at least 18 but not more than 22
- 25 — Of at least 23 but not more than 27
- 30 — Of at least 28 but not more than 34
- Watershed Boundary

MAP 4
"Rt" FACTOR MAP
CITRUS COVE
208 PILOT STUDY AREA

FRESNO COUNTY
APRIL, 1978

0.5 0
MILES

0.5 0
KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE

LEGEND

Areas in which the average slope of the land above horizontal ranges from:

A	0-3 Percent
B	3-9 Percent
C	9-15 Percent
D	15-30 Percent
E	30-50 Percent
F	50 Percent and Greater
—	Watershed Boundary

MAP 5
SLOPE MAP
CITRUS COVE
208 PILOT STUDY AREA

FRESNO COUNTY
APRIL, 1978

0.5 0 0.5 1 MILES

0.5 0 0.5 1 KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT OF AGRICULTURE

R. 24 E.

119° 20'

R. 25 E.

36° 42' 30"

T. 14 S.

HG

GF

X

Kaktus Körner

CITRUS COVE

JENSEN AVE

MAVERICK AVE

WAKEFIELD AVE

Granite

LEGEND

HG Hardwoods and Grass
GF Grass and Forbs
X Other

Watershed Boundary

MAP 6
VEGATATION MAP
CITRUS COVE
208 PILOT STUDY AREA

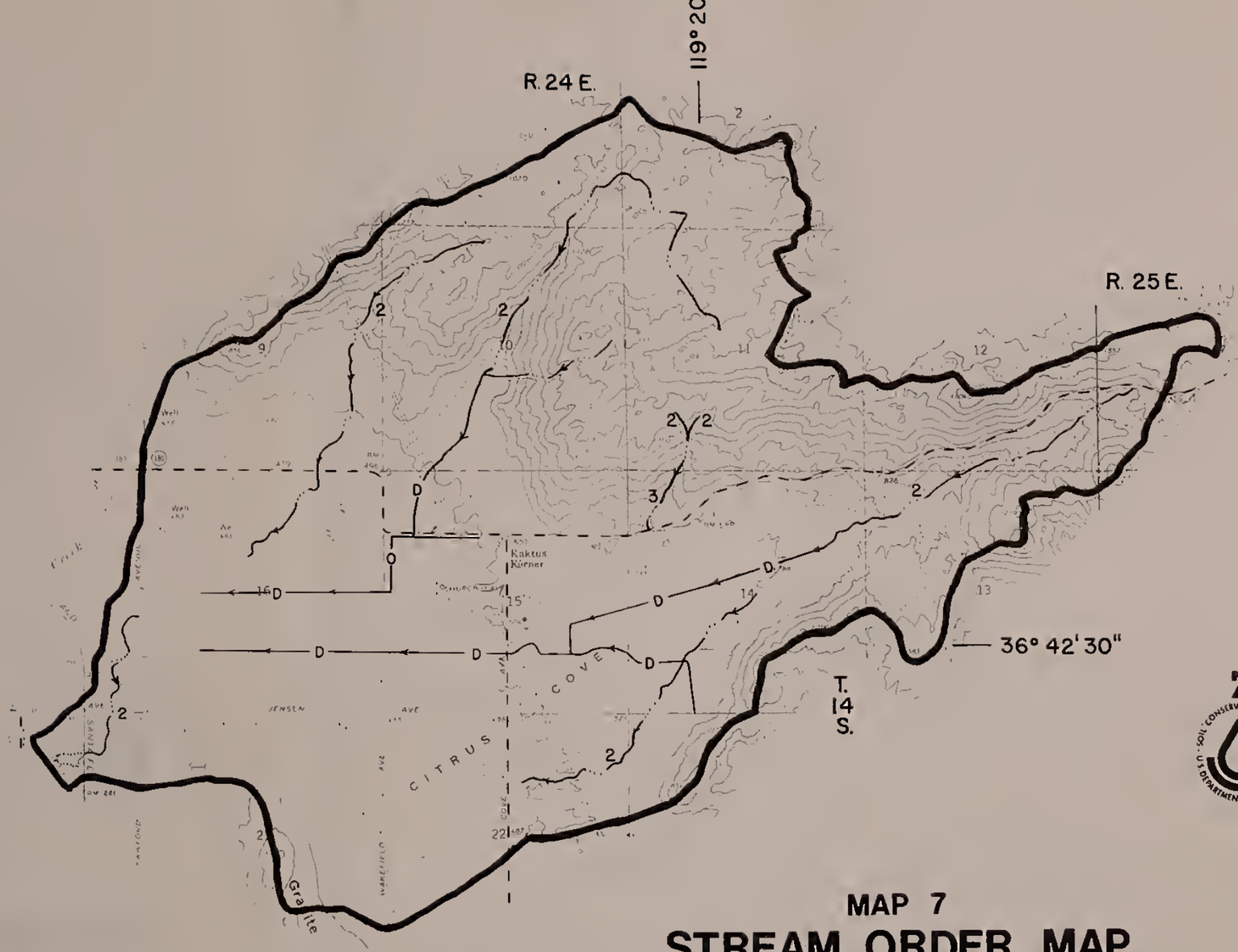
FRESNO COUNTY
MARCH, 1978

0.5 0 MILES

0.5 0 KILOMETERS

KILOMETERS

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE



LEGEND

2 Second Order Stream
3 Third Order Stream

Perennial Stream
Intermittent Stream
D Ditch
Watershed Boundary

MAP 7
STREAM ORDER MAP
CITRUS COVE
208 PILOT STUDY AREA

FRESNO COUNTY
MARCH, 1978

0.5 0 MILES

0.5 0 KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE ·

LEGEND

- Secondary or Medium Duty Road
- Light Duty, All Weather Road
- Unimproved Dirt Surface Road
- Road Maintained by the State
- Road Maintained by a City or County
- Railroad, Single Track
- Watershed Boundary

MAP 8
TRANSPORTATION FACILITIES MAP
CITRUS COVE
208 PILOT STUDY AREA

FRESNO COUNTY
DECEMBER, 1977

0.5 0 MILES

0.5 0 KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE

R. 24 E.

R. 25 E.

119° 20'

36° 42' 30"

T. 14 S.

LEGEND

10 Acre Sample Site locations

Watershed Boundary

MAP 9

SAMPLE SITE INDEX

CITRUS COVE

208 PILOT STUDY AREA

FRESNO COUNTY

APRIL, 1978

0.5 0 1

MILES

1 0.5 0

KILOMETERS

N

SOIL CONSERVATION SERVICE · U.S. DEPARTMENT of AGRICULTURE